

Remarks

Thorough examination by the Examiner is noted and appreciated.

The claims have been amended and new claims added to distinguish Applicants claimed invention over the prior art.

Support for the amended and newly presented claims are found in the original claims and/or Specification. For example amended claim 19 and new claim 21 find support in the Specification at paragraph 0043 on page 21:

"Suitable plasma reactor operating conditions in for example a dual RF plasma reactor include hydrofluorocarbon and O₂ gas feed rates of, for example, CF₄ at 20 to 50 sccm and O₂ at 10 to 20 sccm with a total pressure of about 5 to about 20 mTorr while maintaining the first RF power source at about 200 to about 300 Watts and the second RF power source at about 100 to 150 Watts."

The remaining amendments and newly drafted claims find support in the original claims and/or the Specification. No new matter has been entered.

Claim Rejections under 35 USC 102(e)

Claims 1, 2, 10, 12-14 are rejected under 35 USC 102(b) as being anticipated by Miller et al. (US Pat No. 6,464,568).

Miller et al. who describe a process for removing copper oxide over copper features prior to a CMP process is not sufficient to anticipate Applicants claimed invention as amended to apply to tungsten oxide over tungsten, the exemplary embodiment presented in Applicants Specification.

Further, Miller et al. disclose using a chelating organic **acid** buffer system (col 5, lines 46-47), specifically carboxylic acids (col 6, lines 24-27) where the pH is disclosed to be 2.5 to 4 (col 6, lines 35-38). Miller et al disclose that KOH may be added to the organic acid to create a buffer system (col 6, lines 32-33). Miller discloses that the copper oxide cleaning process takes place on a polish tool (col 5, lines 59-60).

Miller et al. do not disclose Applicants claimed invention in either Applicants amended claims 1 or 13. For example Applicants amended claim 1 claims:

"A method for pre-etching a semiconductor wafer comprising tungsten oxide prior to a chemical mechanical polishing (CMP) process to achieve a uniform tungsten polishing rate comprising the steps of:

providing a wafer process surface having a layer of tungsten oxide overlying tungsten to be chemically mechanically polished;

removing the layer of ~~an~~ tungsten oxide according to an etching process selected from the group consisting of dry etching with a fluorocarbon etching chemistry and wet etching with a aqueous basic solution;

cleaning the semiconductor wafer to include the wafer process surface according to a wet cleaning process; and,

chemically mechanically polishing the wafer process surface according to a CMP process comprising applying at least an abrasive slurry to the wafer process surface."

In particular, Miller et al. does not disclose a dry etching process and does not disclose a wet etching process with an aqueous basic solution, nor disclose a method for removing tungsten oxide.

Claim Rejections under 35 USC 103(a)

Claims 3-6, 11, 15-18 stand rejected under 35 USC 103(a) as being unpatentable over Miller et al. as applied above, and further in view of Torii (US 2002/0068451).

Torii describes a method for removing tungsten oxide over tungsten prior to a tungsten polishing process (see abstract). Torii disclose a multi-step polishing process for first removing the tungsten oxide and then polishing the tungsten (paragraphs 0027 and 0028). In one embodiment Torii discloses using a wet etching method by dipping in an alkali aqueous solution of sodium hydroxide or potassium hydroxide (paragraph 0033). Torii does not disclose a pH for the alkali aqueous solution. Torii also discloses a sputter etch method using argon to remove the tungsten oxide prior to polishing (paragraph 0034).

There is no apparent reason for combining the teachings of Miller et al and Torii et al. since they are directed at different inventions and methods for removing different types of oxides prior to a polishing process. There is no reason to expect the method for removing copper oxide disclosed by Miller et al. would be successful in the process of Torii for removing tungsten oxide.

Nevertheless, such combination of Miller et al and Torii et al. does not produce Applicants claimed invention. Torii does not disclose a dry etching method using fluorocarbons. Torii does not disclose a pH of the alkali solution or whether it is basic or not. Torii does not disclose a cleaning process prior to the CMP process or disclose agitating the process surface either during the wet etching or a cleaning process.

Claims 7, 8, 19, and 20 stand rejected under 35 USC 103(a) as being unpatentable over Miller et al. and Torii as applied above, and further in view of Mathuni et al. (US 4,390,394).

Applicants reiterate the comments made above with respect to Miller et al. and Torii et al. Examiner argues that "a dry etching method as reactive ion etching with fluorocarbon or hydrofluorocarbon to remove metal oxide is a well known method to one skill in the art as shown here by Mathuni (col 3, lines 10-12, col 4, lines 14-16)".

Applicants do not agree that Examiners statement is applicable or relevant to Applicants claimed invention or agree with Examiners characterization of the teachings of Mathuni et al.

Mathuni et al. disclose using a metal oxide as an etching mask in a dry **etching process with an ion beam** (see Abstract). Mathuni et al. discloses that a fluorocarbon e.g., trifluoromethane is used as an etching gas in the ion beam etching method and discloses the use of metal oxides such as TiO , Al_2O_3 , Ta_2O_5 , MgO , MnO , and VO to be used as the etching mask, exhibiting high etching selectivity with respect to the underlying etched oxide layer (col 2, lines 20-30). Mathuni et al. is largely irrelevant to Applicants disclosed and claimed invention. Applicant does not disclose or claim an **ion beam etching method** or disclose or claim the use of a high selectivity metal oxide etching mask. Nevertheless, Applicants respectfully point out that whether an individual step in Applicants invention is well known in the art is irrelevant to the issue of patentability.

"The fact that references relied upon teach that all aspects of the claimed invention were individually known in the art is not sufficient to establish a prima facie case of obviousness without some objective reason to combine the teachings of the references." *Ex parte Levengood*, 28 USPQ2d 1300 (Bd. Pat. App. & Inter. 1993).

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Claim 9 stands rejected under 35 USC 103(a) as being unpatentable over Miller et al. as applied above, and further in view of Small et al. (US 5,981,454).

Small et al. discloses a post CMP cleaning process (see e.g., Abstract, col 4, lines 35-49) to remove traces of slurry. Small et al. generally discloses using brush scrub and a rinse cycle.

Small et al. does not disclose a tungsten oxide etching process or disclose a post tungsten oxide etching cleaning process or suggest that oxide particles which remain following a tungsten oxide etching process should be removed prior to a CMP process or a method for doing so. Moreover, there is no apparent reason for combining the teachings of Miller et al. with the teachings of Small et al. Examiner appears to be using Applicants disclosed and claimed invention as a roadmap to find bits and pieces of Applicants disclosed and claimed invention, thereby engaging in prohibited hindsight reasoning. In any event, such combination does not produce Applicants claimed invention and further does not address the limitations in Applicants amended claims, 3, 4, 9, 13, 15 and 16.

Even assuming *arguendo* that Small et al. discloses an aspect of Applicants claimed invention, as pointed out previously, "The fact that references relied upon teach that all aspects of the claimed invention were individually known in the art is not sufficient to establish a prima facie case of obviousness without some objective reason to combine the teachings of the references." *Ex parte Levengood*, 28 USPQ2d 1300 (Bd. Pat. App. & Inter. 1993).

"First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. **Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations.** The teaching or suggestion to make the claimed combination and the reasonable expectation of success **must both be found in the prior art, and not based on applicant's disclosure.**" *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991)) Emphasis added.

The Claims have been amended to distinguish Applicants claimed invention over the prior art. A favorable consideration of Applicants' claims is respectfully requested.

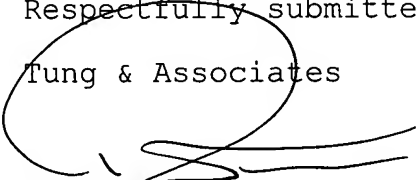
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Based on the foregoing, Applicants respectfully submit that the Claims are now in condition for allowance. Such favorable action by the Examiner at an early date is respectfully solicited.

In the event that the present invention as claimed is not in a condition for allowance for any other reasons, the Examiner is respectfully invited to call the Applicants' representative at his Bloomfield Hills, Michigan office at (248) 540-4040 such that necessary action may be taken to place the application in a condition for allowance.

Respectfully submitted,

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